Population-Based Surveillance for *Yersinia enterocolitica* Infections in FoodNet Sites, 1996–1999: Higher Risk of Disease in Infants and Minority Populations

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Active surveillance for laboratory-confirmed *Yersinia enterocolitica* (YE) infections was conducted at 5 Foodborne Diseases Active Surveillance Network (FoodNet) sites in the United States during 1996–1999. The annual incidence averaged 0.9 cases/100,000 population. After adjusting for missing data, the average annual incidence by race/ethnicity was 3.2 cases/100,000 population among black persons, 1.5 cases/100,000 population among Asian persons, 0.6 cases/100,000 population among Hispanic persons, and 0.4 cases/100,000 population among white persons. Incidence increased with decreasing age in all race/ethnicity groups. Black infants had the highest incidence (141.9 cases/100,000 population; range, 8.7 cases/100,000 population in Minnesota to 207.0 cases/100,000 population in Georgia). Seasonal variations in incidence, with a marked peak in December, were noted only among black persons. YE infections should be suspected in black children with gastroenteritis, particularly during November–February. Culturing for YE should be part of routine testing of stool specimens by clinical laboratories serving populations at risk, especially during the winter months.

Yersinia enterocolitica (YE) is a substantial cause of febrile gastroenteritis in much of the industrialized world. However, the identification of YE disease in the United States has been limited by infrequent use of optimal culture techniques (e.g., the routine use of selective media). Swine are the most common reservoir of this pathogen. Outbreaks of disease have been associated with a variety of contaminated food products, and both outbreaks and sporadic disease have been linked to the consumption of pork byproducts [1–3]. YE serotypes O:3, O:8, and O:9 are most often associated with human disease, with serotype O:3 predominating in countries where disease is endemic (i.e., Belgium, Canada, Japan, Norway, and Denmark) [4, 5]. Before 1980, YE serotype O:8 was the most frequently identified serotype in human disease in the United States. During the 1990s, serotype O:3 emerged in the United States and was recognized as a substantial cause of gastroenteritis in black children living in urban areas; YE O:3 appears to be largely acquired from pork byproducts [3, 6, 7].

We conducted active, laboratory-based surveillance

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for YE infections within the Foodborne Diseases Active Surveillance Network (FoodNet), which is part of the Emerging Infections Program (EIP) of the Centers for Disease Control and Prevention (CDC). FoodNet is a collaborative project among the CDC, EIP sites in 9 states, the US Department of Agriculture, and the US Food and Drug Administration. We summarize the findings of surveillance for YE infections conducted in the 5 original FoodNet surveillance areas (also called "FoodNet sites") during 1996–1999.

METHODS

Beginning in 1996, active laboratory- and population-based surveillance for YE was conducted in Minnesota, Oregon, and selected counties in California (Alameda and San Francisco), Connecticut (Hartford and New Haven), and Georgia (Clayton, Cobb, DeKalb, Douglas, Fulton, Gwinnett, Newton, and Rockdale). These 5 sites constitute the original FoodNet surveillance area, and our data refer to this area for the years 1996–1999. The 1999 US Census Bureau estimated the population in this area to be 14.8 million people, or 5% of the US population. The age distribution of the population under surveillance was consistent across sites over all 4 years; ~1% of the population was aged <1 year, 8% were aged 1–7 years, and 90% were aged >7 years. We conducted the study in accordance with guidelines for human research as specified by the US Department of Health and Human Services.

We collected data on culture-confirmed cases of YE infection (from any specimen except urine) that occurred between 1 January 1996 and 31 December 1999. All clinical laboratories that process stool samples in the FoodNet surveillance area were contacted at least monthly to ascertain cases. Periodic audits of laboratory records were conducted to identify missed cases. A case-report form was used to collect information on cases of YE infection. The case-report form consisted of demographic information and outcome (e.g., hospitalization and death). FoodNet personnel entered data into the Public Health Laboratory Information System, which was transmitted electronically, without personal identifiers, to the CDC. At the time of data analysis, a list of cases of YE infection occurring in persons of unknown race/ethnicity was sent to the FoodNet site coordinators at each site. FoodNet staff at each site attempted to ascertain race and ethnicity for these subjects by rechecking case-report forms, reviewing hospital records, or contacting medical providers.

The case-report form consisted of separate variables for race and ethnicity. For the purpose of our analysis, the following variables were combined into the category of race/ethnicity: Asian, black, Hispanic, Native American, white, or unknown. Subjects of known or unknown race with known Hispanic ethnicity were classified as "Hispanic." Non-Hispanics and persons of unknown ethnicity were assigned to racial groups (i.e., Asian, black, Native American, and white). Aggregate rates for race/ethnicity were adjusted for incompleteness of data by assuming that, each year, within each FoodNet site, the race/ethnicity distribution of subjects without data was identical to that of subjects with data available.

To determine incidence, 1996–1999 postcensus estimates from the US Census Bureau were used. All counties under surveillance in California, Connecticut, and Georgia were classified by the census as "urban" counties; in Minnesota and Oregon, urban counties made up 69% and 73%, respectively, of the state populations.

In 1997, we conducted a survey of laboratory practices in all clinical laboratories that process stool specimens from patients in the 5 original FoodNet sites. The laboratory survey was conducted to determine which pathogens are included in routine bacterial stool cultures and what media are used for routine culturing and under special circumstances (e.g., bloody stool and physician request). We assumed that cefsulodin-irgasan-novobiocin (CIN) agar is the optimal isolation media for YE, and the laboratory survey results were used to calculate an adjusted incidence of enteric YE infection in 1997 for each FoodNet site. This adjusted incidence is the estimated incidence if all laboratories had routinely tested all stools with CIN media and is based on the collective proportion of stool samples rou-

Table 1. Average population race and ethnicity distribution by Foodborne Diseases Active Surveillance Network (FoodNet) site, 1996–1999.

FoodNet site (average total population, 1996–1999)	Percentage of the FoodNet site population				
	Asian	Black	Hispanic	Native American	White
California (2,118,821)	23.9	15.0	17.5	0.4	43.2
Connecticut (1,622,073)	2.1	10.4	9.3	0.2	78.0
Georgia (2,814,198)	3.3	29.8	3.7	0.2	63.0
Minnesota (4,711,059)	2.5	2.8	1.8	1.2	91.7
Oregon (3,261,338)	3.0	1.6	6.0	1.2	88.2
All sites combined (14,527,487)	5.8	10.4	6.2	0.8	76.8

tinely screened for YE in the laboratories serving each FoodNet site according to the 1997 laboratory survey. This adjustment assumes that the incidence of enteric YE infection in populations served by laboratories that do not routinely screen with CIN agar for *Yersinia* species is the same as the incidence in populations served by laboratories that do routinely screen with CIN agar. Pearson's correlation coefficient was calculated to describe the relationship between the percentage of stool specimens screened with CIN and the measured incidence of enteric YE in each site.

RESULTS

Surveillance population. The average distribution of race/ethnicity of the entire population of the surveillance area over the 4 years was 77% white, 10% black, 6% Hispanic, 6% Asian, and 0.8% Native American. This distribution varied across sites, with California being the most diverse and Oregon and Minnesota being the least diverse (table 1).

Demographics and clinical information. At the time of the data analysis in 2001, the database included 527 patients from whom YE had been isolated during 1996–1999. Georgia contributed 199 (38%) of the cases to the study population, the most out of the 5 FoodNet sites (table 2). Of the 527 cases of YE infection, 265 (50%) were among male subjects; of the 433 subjects with known race/ethnicity, 195 (45%) were black, 163 (38%) were white, and 52 (12%) were Asian. Median age varied by surveillance site (California, 5 years; Connecticut, 5 years; Georgia, 7 months; Minnesota, 35 years; and Oregon, 18 years). The 199 patients from Georgia had a lower median age than the 328 patients from all other sites (7 months vs. 13 years; $P < .001$). The median age also varied by race/ethnicity (Asian, 32 months; black, 7 months; Hispanic, 29 months; Native American, 21 months; and white, 30 years). The 163 white patients had a higher median age than the 270 nonwhite or Hispanic patients (30 vs. 1 year; $P < .001$). Black infants (aged <1 year) accounted for 137 (26%) cases. The most frequent culture source was stool or rectal swab ($n = 493$; 93%). YE was isolated from blood samples for 18 (3%) patients. The 45 persons aged ⩾60 years were 6.8 times more likely to have bacteremia than the 482 younger persons with YE infection (16% vs. 2%; 95% CI, 2.8–16.7). Other culture sources were wound (4 patients), joint (3 patients), biliary tract (3 patients), lymph node (2 patients), eye (1 patient), CSF (1 patient), and unknown source (2 patients).

The hospitalization status was known for 489 patients (93%). Among these, 138 (28%) were hospitalized for a median of 4 days (range, 2–34). Elderly persons (age, ⩾60 years) and infants (age, <1 year) had a higher risk for hospitalization with YE infection than other patients (relative risk [RR], 2.6 [95% CI, 1.8–3.9] and RR, 1.9 [95% CI, 1.4–2.6], respectively). Two deaths occurred among the 527 patients; both were adults.

Twenty-two (16%) of 138 hospitalized patients had YE first isolated from a specimen obtained after the second hospital day (median days after hospitalization for the 22 patients, 5.5 days; range, 3–17 days). Of these, 15 were patients with positive culture results (11 stool, 2 joint fluid, and 2 blood) obtained during the first week of hospitalization and 4 were patients with positive stool culture results obtained in an outpatient setting 2–12 days after they had been discharged from the hospital (range of hospital stay, 2–6 days). No information regarding the reason for hospitalization was available from the surveillance data. The remaining 3 patients were a 13-year-old girl with a positive stool culture result on hospital day 15, a 93-

Table 2. Characteristics of 527 patients with *Yersinia enterocolitica* infection and selected incidence—Foodborne Diseases Active Surveillance Network (FoodNet), 1996–1999.

Characteristic	No. (%) of patients	Population[a]	Incidence[b]
Year of incidence			
1996	148 (28.1)	14,281,096	1.0
1997	125 (23.7)	14,424,944	0.9
1998	141 (26.8)	14,621,702	1.0
1999	113 (21.4)	14,782,206	0.8
State of incidence			
California	101 (19.2)	2,118,821	1.2
Connecticut	47 (8.9)	1,622,073	0.7
Georgia	199 (37.8)	2,814,198	1.9
Minnesota (all counties)	117 (22.2)	4,711,059	0.6
Metropolitan counties	80 (68.0[c])	3,256,588	0.6
Oregon (all counties)	63 (12.0)	3,261,338	0.5
Metropolitan counties	48 (76.0[c])	2,369,855	0.5
Race/ethnicity			
Black	195 (45.0)	1,512,615	3.4[d]
White	163 (37.6)	11,150,248	0.5[d]
Asian	52 (12.0)	849,077	2.0[d]
Hispanic	21 (4.8)	905,143	0.7[d]
Native American	2 (0.5)	329,582	0.6[d]
Unknown	94 ([d])		
Age, years			
<1	197 (37.4)	196,630	25.1
1–4	84 (15.9)	789,096	2.7
5–59	201 (38.1)	11,288,100	0.4
⩾60	45 (8.5)	2,253,661	0.5

[a] Average population when years are combined.
[b] For individual years, no. of cases/100,000 population. For state, race/ethnicity, and age groups, average of yearly incidence.
[c] Percentage of total cases in Minnesota and Oregon, respectively.
[d] Race/ethnicity-specific incidence was adjusted for incompleteness of data by assuming that each year, within each FoodNet site, the race/ethnicity distribution of cases with unknown race/ethnicity was identical to the distribution of cases with known race/ethnicity.

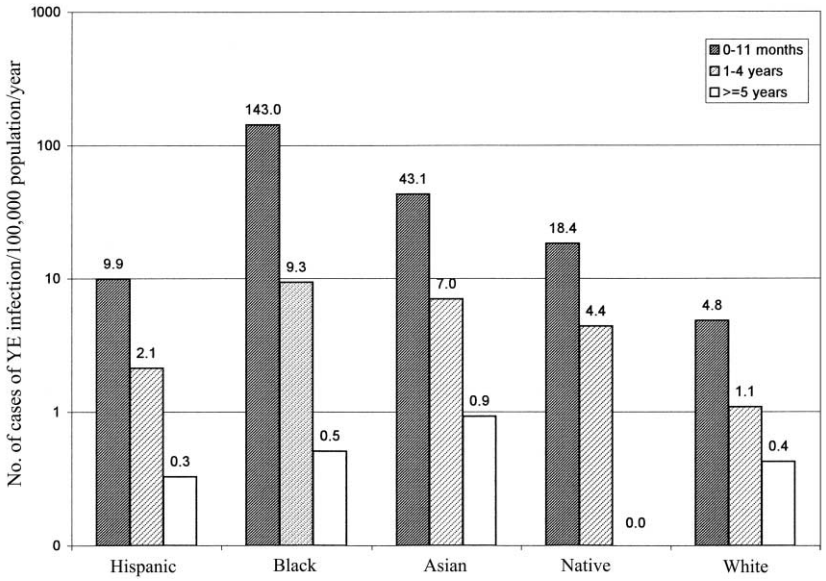

Figure 1. Adjusted incidence of *Yersinia enterocolitica* (YE) infection, by race and age. Average incidences are given over the 4-year surveillance period (1996–1999) by age group and adjusted race/ethnicity. Subjects with unknown race/ethnicity in each FoodNet site were assigned race/ethnicity in the same distribution as cases with known race/ethnicity in the same age group.

year-old woman with a positive stool culture result on hospital day 16, and a 73-year-old man with a positive wound culture result obtained on the 15th hospital day.

Coinfection with a second pathogen was documented in 17 (3%) of the YE infections: 13 patients were coinfected with *Salmonella,* 2 patients were coinfected with *Shigella,* and 2 patients were coinfected with *Campylobacter.* The 291 children aged ⩽5 years were 6.1 times more likely to be infected with a second pathogen than were the 236 older persons (5% vs. 1%; 95% CI, 1.4–26.3).

Incidence, seasonal variation, and urban versus rural incidence. Incidences by year, site, race/ethnicity group, and age group are shown in table 2. Increasing incidence with decreasing age was observed for all race/ethnicity groups (figure 1). The highest average annual incidence among race/ethnicity and age groups was among black infants, with 143 cases/100,000

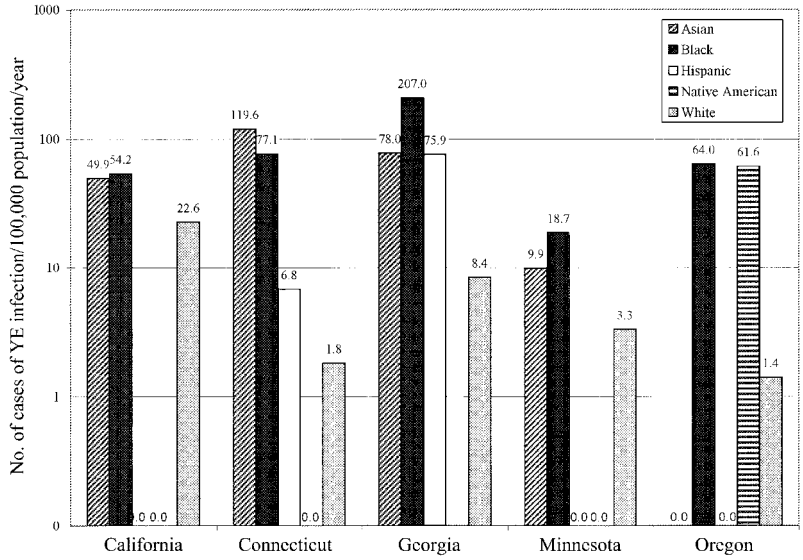

Figure 2. Adjusted incidence of *Yersinia enterocolitca* (YE) infection in infants aged <12 months, by site and race/ethnicity. Average incidence rates over the 4-year surveillance period (1996–1999) by FoodNet site and adjusted race/ethnicity are given.

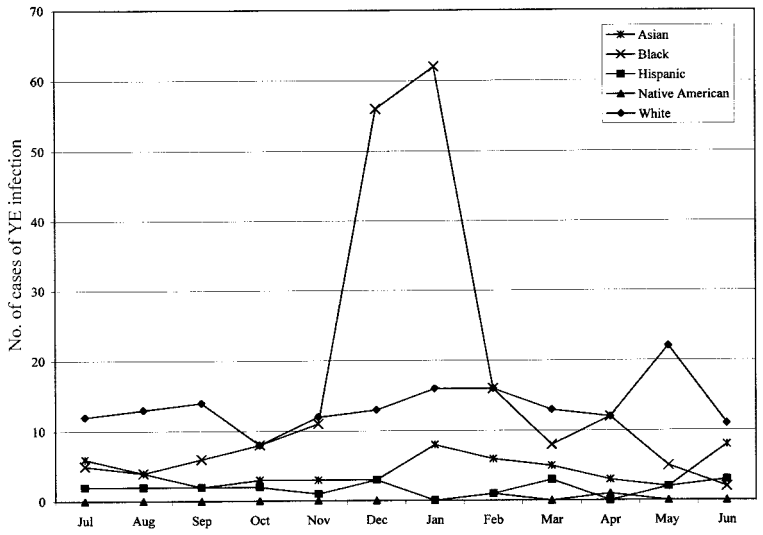

Figure 3. Seasonal distribution of *Yersinia enterocolitica* (YE) infections, by race/ethnicity, 1996–1999. No. of *Y. enterocolitica* infections, by month and race/ethnicity over the 4-year surveillance period, are given. Subjects with unknown race/ethnicity were not included.

population (figure 1). The incidence for infants by race/ethnicity and by FoodNet site revealed increased rates in black and Asian infants, compared with white infants, in all sites except Oregon (where black infants alone had a higher incidence than whites) (figure 2). In California, Connecticut, and Oregon, the incidence of YE for all ages combined was higher among Asian persons than black persons; the incidence of YE in Asian persons was also high (relative to the incidence in white persons) in all age groups in California, whereas, in Connecticut, the incidence of YE in Asian infants and young children accounted for all disease, and, in Oregon, no cases of YE disease among Asian infants were ascertained (data not shown).

Overall, 48% (255) of cases occurred during November–February. Seasonal distribution was marked among black persons, with 74% of 195 cases occurring during these winter months, compared with 33% of the other 238 cases among nonblack persons ($P < .001$) (figure 3).

Rates decreased 20% overall during 1996–1999 (from 1.0 to 0.8 cases/100,000 population) (table 1). These decreases were noted in both infants (decreasing from 32.0 to 19.0 cases/100,000 population, a 41% decrease) and children aged 1–5 years (decreasing from 3.9 to 1.5 cases/100,000 population, a 62% decrease). Decreases in incidence for infants and young children were observed in all races and ethnicities, with a 37% decrease among black infants (decreasing from 176.7 to 110.8 cases/100,000 population) and a 65% decrease among black children aged 1–5 years (from 14.6 to 5.1 cases/100,000 population).

In Oregon and Minnesota, 76% and 68% of the patients resided in urban counties, respectively (table 2). The incidence of YE in urban counties in both Minnesota (0.6) and Oregon (0.5) was not different than the respective statewide incidences (0.6 and 0.5, respectively). However, incidence in infants residing in urban counties was higher than in infants residing in other counties (Minnesota, 19.5 urban cases/100,000 population vs. 6.0 cases from other counties/100,000 population; Oregon, 12.6 urban cases/100,000 population vs. 8.7 cases from other counties/100,000 population).

Laboratory practices. Among 235 laboratories that performed stool cultures in the surveillance areas in 1997, 224 reported the annual number of stool cultures performed. Overall, 25% of stool specimens processed in 1997 were routinely

Table 3. Incidence of *Yersinia enterocolitica* (YE) infection, adjusted by laboratory culturing practices, Foodborne Diseases Active Surveillance Network (FoodNet) 1997.

Incidence or practice	California	Connecticut	Georgia	Minnesota	Oregon	All sites
Incidence of enteric YE, cases/100,000 population/year	1.6	0.4	1.3	0.6	0.4	0.8
Percentage of stools processed by laboratories that always screen for YE with CIN	26.6	4.5	18.0	19.2	7.4	16.5
Adjusted incidence estimate of enteric YE, cases/100,000 population/year[a]	6.1	9.5	7.4	3.0	5.9	5.0

[a] Incidence times 100% of stools processed by laboratories that always screen for YE with cefsulodin-irgasan-novobiocin (CIN).

tested for YE (range, 12% in Connecticut to 37% in California), and 17% of all stool samples were routinely tested for YE with CIN agar (range, 5% in Connecticut to 27% in California). Laboratories that reported screening all stool samples for YE ($n = 63$) and those that reported screening all stool samples with CIN agar ($n = 32$) were more likely than the other laboratories (161 and 192, respectively) to have isolated YE during 1997 (RR, 2.4 [95% CI, 1.3–4.4] and 2.4 [95% CI, 1.3–4.5], respectively).

The adjusted incidence of enteric YE infection was calculated as described in Methods for each site on the basis of 1997 survey information (table 3). Overall, the incidence of YE increased from 0.8 to 5.0 cases/100,000 population. Of note, there was some correlation (0.85 across the 5 sites) between the measured incidence and the percentage of stool samples screened; despite this, there was disparity between Minnesota and Georgia, which had similar percentages of stool samples screened (19.2 and 18.0, respectively) but had incidences that differed by a factor of 2 (0.6 and 1.3, respectively).

DISCUSSION

These data provide the first population-based estimates of laboratory-confirmed YE infections in the United States. The overall incidence of YE infection was low in the populations studied, but striking geographic and demographic variation was noted. The most notable features include a high incidence among black infants that was most noteworthy in urban Georgia counties (e.g., metropolitan Atlanta), a higher incidence in Asian than in white persons or Hispanic persons, and a higher incidence with decreasing age in all racial and ethnic groups.

YE usually causes a syndrome of gastroenteritis with diarrhea as the predominant presenting symptom [4]. Other reported acute presentations include pseudoappendicitis (more common in older children and adults) and sometimes monoarthritis after a diarrheal illness. Although the clinical information obtained in our surveillance system is limited, a review of 92 medical charts of 106 laboratory-confirmed YE infections from metropolitan Atlanta that occurred during 1995–1997 (of which data from 68 patients are included in the present article) found that 60% were among black infants, who presented most commonly with diarrhea (95%), fever (80%), vomiting (55%), and bloody stools (52%) [8]. A recent retrospective review of 142 children with laboratory-confirmed enteric YE infections who presented to a hospital in Detroit over a 7-year period found that 85% of the children were aged <1 year, all but 1 were black, and 84% presented during November–January [9]. The most common presenting signs and symptoms were similar to those among patients from Atlanta: diarrhea (100%), fever (74%), bloody stools (50%), and vomiting (40%) [9]. These reviews suggest that febrile gastroenteritis in an infant is the most likely clinical presentation for laboratory-confirmed YE infection in the United States.

A less common syndrome caused by YE is a dramatic illness caused by nosocomial, transfusion-acquired YE bacteremia [10]. Hospital-acquired YE infection may also be foodborne and present as diarrhea. One study found that YE infection presenting as nosocomial diarrhea accounted for 28% of all YE infections over a 4-year period [11]. We found that 22 (16%) of 138 hospitalized patients with laboratory-confirmed YE infection had their first YE-yielding specimen obtained after the second hospital day. Most of these patients had positive culture results during the first week of hospitalization, but several first tested culture positive much later. Without additional medical information, determining whether these patients acquired their infections in the hospital is not possible, but the isolation of YE beyond the first week suggests that nosocomial acquisition is possible. No transfusion-associated cases were reported in our cohort.

Reports that have described the epidemiology of YE infections in the United States have emphasized the occurrence of winter-holiday outbreaks among black infants that are associated with the home preparation of chitterlings (pork intestines) [6, 8, 9]. Surveillance data suggest that this scenario could still account for a substantial proportion of YE infections in the United States. In our study, black infants had the highest incidence of disease. In addition, winter seasonality (November–February) was evident among black persons with YE infections and was not observed in other racial/ethnic groups. Chitterlings are a soul food staple that have long been eaten in the southeastern United States, and their consumption has been closely associated with being African American and with the winter holidays [6]. Raw chitterlings can become contaminated with a variety of pathogenic bacteria, including *Yersinia* and *Salmonella* species [6, 12]. This source of polymicrobial exposure may explain the coinfection with *Salmonella* that is observed in a small percentage of the YE infections in black infants. Although chitterlings are appearing on an increasing number of restaurant menus across the country, the home preparation of chitterlings (with the attendant risk of cross-contamination with swine intestinal flora) is likely infrequent outside of African American communities. Our data suggest that, in our surveillance areas, chitterlings are a less common source of YE infection in other racial or ethnic groups.

The incidence of YE infections in Asian persons, although less than that observed in black persons overall, was 2–4 times higher than that in white and Hispanic persons. In California, Connecticut, and Oregon, Asian persons had a higher incidence of infection than black persons. Prior reports have not identified YE outbreaks or disease risk factors that are specific to Asian communities. The serotyping of the YE isolates, which was not routinely performed in our surveillance area, would

be important to determine whether disease in Asian persons is predominantly caused by YE O:3 and thus is likely associated with exposure to swine products. A case-control study of sporadic YE infections to identify dietary and/or food-preparation risk factors in this racial group is needed.

Among infants, high incidence has been observed of several pathogens that are typically foodborne (including *Salmonella* and *Campylobacter*) in addition to *Yersinia* [13, 14]. The high incidence of these pathogens among infants might be explained by a lower infectious dose in infants resulting from their size and age-related differences in the intestinal tract, a greater likelihood of presentation for care when they are ill with a diarrhea, and a greater likelihood of physicians obtaining culture samples. Infants may acquire these pathogens directly by eating contaminated food or indirectly via the contamination of objects (e.g., bottles, toys, and care providers' hands) that infants subsequently place in their mouths. In some parts of the world, raw ground pork is commonly given to infants without teeth, but this practice is not known to be common in the United States [1].

Because only 2 of our 5 surveillance sites (Minnesota and Oregon) included rural areas, some epidemiology unique to rural locations could be unappreciated. Persons in rural areas might be more likely to have contact with pigs or raw pork products (e.g., during slaughter), placing these persons at higher risk for YE infection. Although stratification by urban and rural location of YE infections in Minnesota and Oregon did not reveal a difference in incidence, there were higher rates observed among infants residing in urban locations in both states. However, a telephone survey among residents of FoodNet sites in 1995–1996 found that the frequency with which persons with a diarrheal illness call or visit a medical provider was higher in urban than in rural areas. [15]. Thus, there may be less access to health care in rural areas, and this may result in lower sensitivity for detecting *Yersinia* infections in the rural population.

Not all clinical laboratories routinely screen stools for YE. Although detectable by an experienced microbiologist, YE may be difficult to identify on agars (e.g, *Salmonella-Shigella,* MacConkey, and selective agar for *Campylobacter* species) that are commonly used for testing a stool specimen. Nevertheless, because routine agar can be used to identify YE, we used the laboratories' self-reported responses as to whether they screened all stool samples for YE to adjust the incidence of YE. Some laboratories also used special selective media for the isolation of YE. CIN agar was the most commonly used agar in the attempt to isolate YE. We found that laboratories that report screening for YE by either method were more likely to isolate YE than other laboratories. In addition, laboratories that used CIN agar were more likely to isolate YE. Other factors in the stool testing process (e.g., the use of special transport media) also might affect culture sensitivity. We found that laboratory practices varied widely across our surveillance area. This variation in the routine screening of stool specimens contributes to the underestimation of the incidence of YE infection. Laboratories that serve populations with a high incidence of YE (e.g., pediatric hospital laboratories in metropolitan Atlanta) may be more likely to screen all stools for YE. Finding some correlation between the measured incidence and percentages of stool screening suggests that variations in the frequency of routine screening could explain some of the variation in incidence between sites.

Using reported stool-screening rates to calculate an adjusted incidence for enteric YE infections is more complex than our analysis suggests. The adjustment model assumes that CIN screening identifies 100% of YE infections and that everything else identifies 0%. This assumption tends to produce large multipliers for adjusted incidence. An adjustment model that assumes a 100% sensitivity for CIN, 50% for other screening methods, and 10% for a "common" agar plate would yield a different picture. Suppose that, for all sites, 16.5% of stools are screened with CIN, 8.5% are screened by other methods, and 75% are cultured on common agar. Then 100% of 16.5% + 50% of 8.5% + 10% of 75% = 28.25% of cases identified. This gives an overall adjusted rate of 0.8/.2825, or 2.8. Data from Connecticut, under a 4.5%/7.5%/88% testing distribution, would result in an adjusted rate of 0.4/.1705, or 2.35. Data from California, under a 26.6%/10.4%/63% distribution, would result in an adjusted rate of 1.6/0.381, or 4.2. The state-to-state order-of-incidence rates would assume a third configuration with this analysis. A more detailed analysis of the effect of laboratory practices on the incidence of YE is needed. The serotyping and biotyping of YE isolates (which are not routinely performed in our surveillance system) have been used to discriminate pathogenic from nonpathogenic strains of YE. This further characterization of YE isolates could help to define clinical syndromes and sources of YE infection.

Over the 4 years of surveillance, the incidence of laboratory-confirmed YE infection decreased slightly. A notable (40%–60%) decrease, however, occurred among infants (37% in black infants) and children aged 1–5 years. These decreases may reflect the success of public health efforts to educate the public about the risks associated with the home preparation of chitterlings. They may also reflect a shift in the marketing of chitterlings to a precleaned product that requires less in-home preparation time. Although the incidence of YE infections in black infants decreased, the incidence in 1999 was still high, which supports the need for continued prevention efforts targeted toward African American communities.

Data stratification by race and ethnicity introduces several possible sources of error. The US Census Bureau data used to calculate our denominator may have underestimated the sizes

of racial and ethnic groups, which would serve to falsely elevate the incidence in these groups. In addition, the unknown race/ethnicity of patients with missing data likely differed from that of patients with known data; our adjustment for unknown race/ethnicity assumed the that the distribution was the same in known and unknown cases and would have thus introduced error. However, race/ethnicity was unknown for only a small proportion of cases. The differences in incidence between black persons and other races and Asian persons and other races are of greater magnitude and consistency than could be explained solely by these types of error.

The incidence of laboratory-confirmed YE infection was highest in metropolitan Atlanta, particularly among black infants. Variations in incidence between surveillance sites was not entirely caused by variations in laboratory practices. A case-control study to identify risk factors for YE infections in the Asian population is needed. Public health messages to prevent YE infection in black infants should be continued. YE infection should be suspected in black children with gastroenteritis, particularly those who present during November–February. Finally, the isolation of YE should be integrated into the routine testing of stool specimens by clinical laboratories that serve populations at risk, especially during the winter months.

FOODNET WORKING GROUP MEMBERS

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